ISSN 1028-334X, Doklady Earth Sciences, 2007, Vol. 417A, No. 9, pp. 1454–1455. © Pleiades Publishing, Ltd., 2007.
Original Russian Text © G.A. Karnaukhova, 2007, published in Doklady Akademii Nauk, 2007, Vol. 417, No. 6, pp. 828–829.

OCEANOLOGY

Mineralogical Features of Sedimentogenesis in the Angara Reservoirs

G. A. Karnaukhova

Presented by Academician A.P. Lisitsyn December 22, 2006

Received November 24, 2006

DOI: 10.1134/S1028334X07090358

The composition of the material from provenances and its changes under the influence of transportation and redistribution are reflected in the lithology of bottom sediments both in natural water bodies and in man-made reservoirs. A great body of interesting data on the mineralogy of sediments in natural water bodies has been collected and analyzed to date [1–5]. Unfortunately, data on the formation of the mineral assemblage in man-made reservoirs are practically unavailable.

This work considers for the first time some mineralogical features of sedimentogenesis in reservoirs of the Angara basin (hereafter, Angara reservoirs), which are based on the results of the mineralogical analysis of a coarse silt fraction of bottom sediments collected by the author of the present communication from 1972 to 2002. The mineralogical outlook of bottom sediments in Angara reservoirs is determined by terrigenous clastic minerals related to the sediment load of rivers and rock abrasion in the shore zone. We have established that the bottom sediments are mainly composed of minerals of light fractions, the share of which varies mostly from 87 to 99%. The light fraction consists mainly of quartz, feldspars, micas, and fragments of carbonate and siliceous rocks. The high content of quartz (9.2–85.9%) and feldspars (2–32%) is related to their terrigenous nature. The heavy fraction is represented by more than 30 minerals. However, most prevalent are 20 minerals, including amphibole, epidote, garnet, ore minerals, titanite, and zircon, which are the most common and abundant. The leading minerals in the heavy fraction are hornblende and ore minerals that account for more than 50% of the fraction. The content of other minerals is $10n\%$, while other constituents are found as individual grains.

Some researchers [6, 4, 7] reported simultaneous mineralogical and mechanical differentiation in lakes, seas, and oceans. The results of investigations showed that mineralogical differentiation also exists in man-made reservoirs characterized by an insignificant (on the geological scale) evolutionary history. The analysis of the distribution of minerals on the bottom of reservoirs allowed us to establish a definite confinement of some minerals to structural elements of the bottom (morphodynamic zones), reflecting conditions of migration, redistribution, and accumulation of minerals in sediments, e.g., coastal shallows, underwater slopes of coastal shallows, flooded terraces, and the flooded bed of the Angara River. The bottom morphology, hydrodynamic conditions, and the composition of the material delivered to reservoirs from provenances are basic factors of mineral distribution in morphodynamic zones.

Active hydrodynamics and a high sedimentation rate do not facilitate the concentration of quartz and feldspar in sediments on coastal shallows of the Angara reservoirs (Fig. 1). Less stable minerals of the heavy fraction are also carried off the coastal zones. A mini-

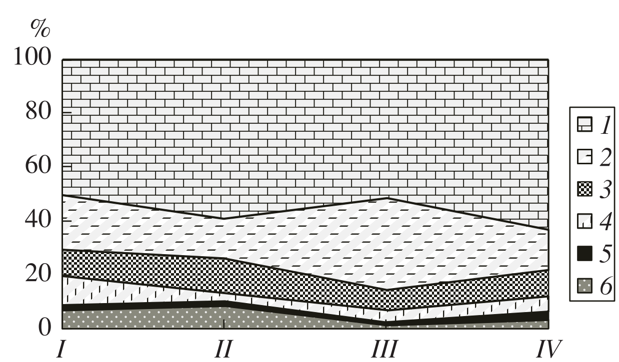

Fig. 1. Distribution of minerals of the light fraction on the summary profile in morphodynamic zones of the Angara reservoirs. Morphodynamic zones: (*I*) coastal shallow zone, (*II*) underwater slope of the coastal shallow zone, (*III*) flooded terraces, (*IV*) the Angara flooded bed. Minerals: (*1*) quartz, (*2*) orthoclase, (*3*) plagioclase, (*4*) mica, (*5*) rock debris, (*6*) aggregates.

Institute of the Earth's Crust, Siberian Branch, Russian Academy of Sciences, ul. Lermontova 128, Irkutsk, 664033 Russia; e-mail: karnauh@crust.irk.ru

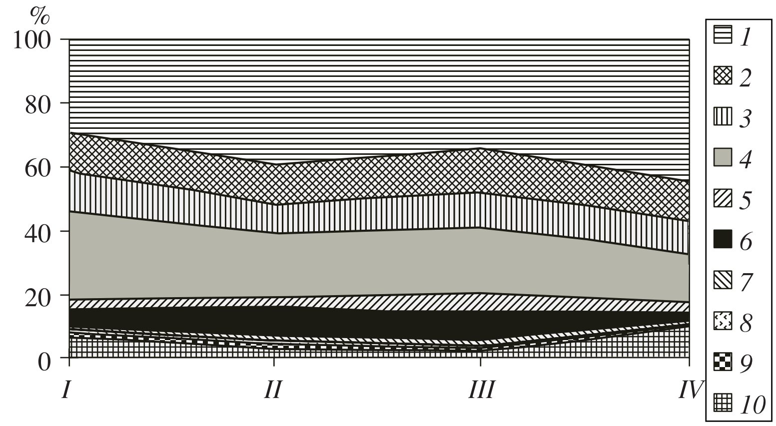

Fig. 2. Schematic distribution of minerals of the heavy fraction on the summary profile in morphodynamic zones of the Angara reservoirs. (*I–IV*) See Fig. 1. Minerals: (*1*) hornblende, (*2*) epidote, (*4*) ore minerals (ilmenite + magnetite), (*5*) pyroxene, (*6*) zircon, (*7*) titanite, (*8*) tourmaline, (*9*) rutile, (*10*) others.

mal accumulation of hornblende (29.5%), epidote (11.7%), and titanite (1.2%) is noted on coastal shallows. At the same time, the shallows serve as a zone of intense concentration of heavy high-density minerals (ore minerals, 27.8%, and garnet, 12.6%) in bottom sediments.

A decrease in the concentration of mineral-indicators of sedimentation (garnet and ore minerals) on coastal shallows is observed on the underwater slope of the shallows. The greater part of heavy minerals is settled and accumulated here. Increase in the content is particularly noticeable for hornblende (39.2%) and stable minerals, such as zircon (8.3%), tourmaline (1.0%), and rutile (1.5%) that represent mineral-indicators of sedimentation on the underwater slope.

Feldspars are unstable to abrasion and carried off the shallows and underwater slopes. Therefore, they are accumulated on flooded terraces of the Angara River over vast areas of the bottom of reservoirs. With increasing distance from the provenance, the content of quartz in sediments decreases and bottom sediments on flooded terraces are depleted in this mineral. Consequently, the bottom sediments accumulate an assemblage of minerals with a low density and high ability to migrate, e.g., epidote (13.7%) and titanite (2.4%).

Significantly dispersed bottom sediments in the flooded riverbed are most favorable for the concentration of quartz, feldspar, and clay minerals. Such a distribution of minerals fits in the scheme suggested for the Pacific and Indian oceans, where the maximum contents of quartz and feldspar are confined to finely dispersed eupelagic clay with a very low sedimentation rate [7]. Owing to smaller sizes of reservoirs relative to natural water bodies, the unstable hornblende can migrate from the provenance and accumulate in the flooded riverbed, whereas the content of other heavy minerals considerably decreases (Fig. 2).

Thus, the materials described above suggest the following conclusion. The mineralogical differentiation of sedimentary material occurs in both man-made reservoirs and natural water bodies. High-density ore minerals and associated garnet are concentrated under active hydrodynamic conditions. Attenuation of dynamic activity of water masses is accompanied by the formation of an assemblage of less transportable minerals (zircon, tourmaline, and rutile). Hornblende, epidote, quartz, and feldspar are the most widespread minerals in sediments of the deep-water zone of reservoirs.

REFERENCES

1. A. N. Derkachev, *Mineralogical Features of the Marginal Marine Sedimentogenesis (Exemplified by the Sea of Japan)* (Dal'nauka, Vladivostok, 1996) [in Russian].
2. E. M. Emel'yanov, in *Oceanological Studies* (Sov. Radio, No. 26, 61 (1979).
3. I. O. Murdmaa, A. P. Lisitsyn, E. M. Emel'yanov, et al., in *Geology of the Ocean: Sedimentation and Magmatism of the Ocean* (Nauka, Moscow, 1979), pp. 163–268.
4. A. P. Lisitsyn, *Processes of Terrigenous Sedimentation in Seas and Oceans* (Nauka, Moscow, 1961) [in Russian].
5. *Lithology and Geochemistry of Recent Lacustrine Deposits in the Humid Zone* (Nauka, Moscow, 1979) [in Russian].
6. N. M. Strakhov, *Lithogenesis Types and Their Evolution in the Earth's History* (Gosgeoltekhizdat, Moscow, 1963) [in Russian].
7. V. V. Serova, A. P. Lisitsyn, and I. O. Murdmaa, Litol. Polezn. Iskop., No. 6, 36 (1975).